

Following is a set of guidelines to aid in the development of type, size and location (TS&L) plans for bridges and large culverts and in the preparation of pink sheets and plats for small culverts. Please note that most of this material are guidelines, not policies. Sound engineering judgment, including technical and economic analysis, must be applied in all situations.

Earlier editions of this document are hereby superseded. Changes in this revised edition include dimensions in English and metric units, and additional information in the appendices.. Also, the June 1995 “Design Aids for Roadway Culvert Designs” is superseded. Its contents have been incorporated into this document.

Culverts

General drainage policy

In the construction of rural highways in Iowa it is of primary importance that there be minimal diversion of surface water. Water entering the highway right of way in a draw (swale or ditch) should generally be carried through the highway embankment and discharged into the same draw. Although it is not possible to leave unchanged every square foot of watershed, this policy of “minimal diversion” shall be adhered to as closely as practical.

The term “minimal” is difficult to quantify but may be viewed in terms of percentage change and of potential impacts to affected properties. For example, altering a 150-acre watershed to 152 acres may have minor effects on peak flow, but altering a 5-acre watershed to 10 acres may adversely affect farming practices on a given property. In much rarer instances, decreasing drainage area may also have an adverse impact. One actual example is a 7-acre watershed that was diverted to a much larger basin. During construction, the landowner made IDOT aware that the 7-acre watershed was a significant water supply source to a pond used for watering livestock.

On highway relocations, be aware that field fences may have enough soil built up to create a “ridge” where water does not cross. In effect, these fences may create distinct watershed boundaries and become as important as any “natural” watershed boundary. Avoiding diversion in these instances must be considered when the highway relocation cuts through these fence “ridges”.

Hydrology

Rural For drainage areas less than 1280 acres (518 hectares), use the Iowa Runoff Chart (see Appendix A). For larger drainage areas, use USGS Scientific Investigation Report 2013-5086.

If a project site is not located in a detailed FIS, the methodology contained in USGS Scientific Investigation Report 2013-5086 should be used to estimate peak discharges for the design of

culverts. A copy of the report can be obtained at the USGS web site <http://pubs.usgs.gov/sir/2013/5086>. The USGS has developed a web based program called “Streamstats” that calculates the estimated peak discharges from Report 2013-5086 which can be obtained at the following website: <http://water.usgs.gov/osw/streamstats/index.html>.

USGS Report 2013-5086 has defined three different regions for the state and utilizes a three-variable equation for each region. It should be noted that the Streamstats program will assume the entire drainage basin is representative of the region from which it is located. For example, if the project site is located in Region 2 and a significant portion of the basin is location in Region 1, the program will calculate the peak discharges assuming the entire basin and pertinent variables are located in Region 2.

The Iowa DOT has developed an Annual Exceedence - Probability Discharge (AEPD) spread sheet which provides an alternative method for calculating peak discharges when a basin is representative of a different region or crosses a different regional boundary. The AEPD spread sheet will calculate the peak discharges for the new report and for USGS Reports 87-4132 & 00-4233 and should be used as a tool for comparing the different methodologies to determine if any anomalies are present in estimating the peak discharges. In general, USGS Report 13-5086 provides higher peak discharges than the previous regression equations. The variables for each regression equation, including the Main-Channel Slope (MCS) variable, must be calculated by the Streamstats program.

In general, the AEPD spread sheet should not be used to supersede the estimated peak discharges determined by USGS Report 2013-5086. However, if the AEPD spread sheet determines that Streamstats discharges are significantly different (as compared to the USGS 87-4132 & 00-4233 results), then engineering judgment can be used to estimate peak discharges for the design of bridges and culverts in Iowa.

The links to the Iowa DOT AEPD spread sheet and associated support files are shown below:

http://www.iowadot.gov/bridge/programs/AEPD_Spreadsheet.v1.0.xlsm
http://www.iowadot.gov/bridge/programs/AEPD_Spreadsheet_UsageGuide_120413.pdf

Tables 1, 3 and 4 from USGS Report 2013-5086 in spreadsheet format. For reference use with AEPD Spreadsheet.

http://www.iowadot.gov/bridge/programs/13-5086_tables1&4.091213.xlsx
http://www.iowadot.gov/bridge/programs/13-5086_table3.091213.xlsx

Urban For urbanized areas, use methods such as Rational Formula or NRCS's TR-55.

Design Discharge For the design of crossroad (mainline) culverts, use the 50-year flood.

For most sideroad pipes, use a 50-year flood. For entrances, use a 10-year flood unless the mainline is adversely affected. For temporary pipes under a "runaround", generally use the 5-year flood.

Hydraulics

For culvert hydraulics, use FHWA's publication, "Hydraulic Design of Highway Culverts," Hydraulic Design Series No. 5, September 1985. Equivalent computer software such as HY-8 or Haestad Methods' "CulvertMaster" is also acceptable. Check with the Office for approval of other software.

Culverts should generally be designed to have one foot (0.3 m) of head above the top of the opening at the design discharge. This can be exceeded in some instances if the culvert is under high fill and there is minimal flood damage potential upstream. When the upstream terrain is very flat, be aware that a calculated highwater may not be reached due to large available flood storage. In this circumstance, the designer may need to consider less culvert height and more width to accommodate flows at lower water surface levels.

Size

Minimum pipe size for roadways, sideroads and ditch letdowns is 24 inches (600 mm). This provides adequate opening for maintenance inspections and minimizes the potential for plugging with debris.

Preferred minimum size for median pipes in four-lane roadways is 24 inches (600 mm). In some instances, the median ditch may be too shallow to place a 24 inch (600 mm) pipe under the pavement and subbase, and D sections with various bevels may be used. For areas with minimal drainage or clearance restrictions, an 18 inch (450 mm) pipe may be used.

Minimum pipe size for entrances is 18 inches (450 mm).

Maximum size of concrete pipe culverts is 84 inches (2100 mm). When a larger opening is needed, it is generally more economical to use a cast-in-place reinforced concrete box culvert (RCB). General practice is to use a higher strength pipe (e.g., 3750 D) with Class B bedding before using an RCB.

The following English box culvert sizes are measured in feet of clear Span x Height. Culvert heights are available in 1'-0" increments with the sizes listed below. Fill is defined as depth of fill on top of the Culvert.

Single Culverts are available as Cast-In-Place in the following sizes - 3 x 3, 4 x 4, 5 x 3 thru 5 x

6, 6 x 3 thru 6 x 8, 8 x 4 thru 8 x 10, 10 x 4 thru 10 x 12, 12 x 4 thru 12 x 12.
Fill range for Cast-In-Place Single Culverts is 0 feet to 55 feet at 1 foot intervals.

Single Culverts are available as Precast in the following sizes - 6 x 3 thru 6 x 8, 8 x 4 thru 8 x 10, 10 x 4 thru 10 x 12, 12 x 4 thru 12 x 12.
Fill range for Precast Culverts is 2 feet to 25 feet at 1 foot intervals.

Twin and Triple Culverts are Cast-In-Place multiple barrels sharing common interior walls, i.e. Twin 12 x 8 is two 12 foot spans with a height of 8 foot.

Twin Culverts are available as Cast-In-Place 8 x 4 thru 8 x 10, 10 x 4 thru 10 x 12 & 12 x 4 thru 12 x 12.

Triple Culverts are available as Cast-In-Place 10 x 4 thru 10 x 12 & 12 x 4 thru 12 x 12.
Fill range for Twin and Triple Culverts is 0 feet to 25 feet at 1 foot intervals.

These standard sizes should be used whenever practical. No RCBs smaller than a 3' x 3' shall be used, except in very unusual situations such as extending a small RCB when no precast options are acceptable.

Standard RCB headwall skews (0°, 15°, 30° and 45°) should be used in almost all cases, even when the barrel is at a non-standard skew to the roadway. For example, if the barrel is skewed 20° to the roadway, use a 15° standard headwall. Exceptions would include when the RCB headwall is near the intersection of two roads, and the slope shaping and safety on both roads need to be considered.

The site history of the existing culvert may provide useful information when sizing a proposed culvert. Survey crews should find this information and note it on the pink sheet. IDOT maintenance personnel may have information related to landowners' complaints or road overtopping, which may indicate a larger structure should be designed or the roadgrade needs to be raised. Any such history should be documented in project files or on the pink sheets.

Type

Concrete pipe culverts shall be used under all paved roads, including paved sideroads, and shall have minimum strength of 2000D (100D). The maximum strength is generally 3750D (175D). However, the concrete pipe industry does have a higher strength pipe 4000D/ 200D) that may be used for greater fill heights on a case-by-case basis. Prior approval from the Office of Bridges and Structures is required.

Corrugated metal pipe shall be specified for any temporary pipes (aprons are generally not needed). Unclassified Entrance Pipes shall be specified for entrances. Unclassified Roadway Pipes shall be specified for unpaved sideroads. (When "Unclassified" pipes are called for, the contractor may select the culvert material from the appropriate list in IDOT's Specification 2422.) Either coated steel or polyethylene shall be specified for letdowns. (See the section "Letdowns" later in this document.)

When available head is limited due to low road fill or very flat ground upstream, several alternatives may be acceptable instead of a single, large, round pipe: an arch pipe, twin pipes, or an “oversized” round pipe with the invert buried. (This latter alternative has an advantage of a lower flowline that could be used in the future for a lower ditch flowline.) Cost of the structure may be a determining factor in the type used. Concerning the spacing of twin pipes, provide approximately 3 feet (0.9 m) between the outside edge of the pipes. Cast-in-place drop inlets (see Appendix A) or Road Design Detail 1407 may also be acceptable solutions when available head is limited.

Precast RCB’s are typically bid as an alternative to cast in place for single box culverts. Precast twin and triple RCB’s can be allowed on a case by case basis with Section Leader approval. Check with the BDM Article 8.3 concerning availability and usage. The use of precast RCB’s is limited to fill heights from 2 feet to 25 feet (0.6 m to 7.6 m) and expected settlements of 6 inches (0.15 m).

Stockpasses are not typically installed under four-lane highways since the long sections of barrel inhibit cattle from using the structures. Existing stockpasses under two-lane roadways should be eliminated whenever possible based on present right of way needs and drainage concerns. (The Office of Right of Way will coordinate this with the affected landowner.) For new stockpasses, a 4 foot x 6 foot barrel is the preferred size for cattle; a 5 foot x 7 foot barrel is used for a horse pass. See Road Standard RF-8.

Settlement and Camber

See Office of Bridges and Structures’ Final Design Manual for guidance on the use of camber and bell joints on cast-in-place RCBs. Soils Design Section of the Office of Design will provide the final recommendation for bell joints. Soils Design’s estimated settlements for all culverts (both precast and cast-in-place) should be equivalent to the camber placed in the culverts. For pipe culverts, this camber should be noted in the appropriate column on the pipe culvert bid tabulation 104-3. Note that all proposed pipe culverts under the primary highway system should be Class B bedding (See RF-30A and RF-31).

Horizontal Alignment

Generally, culverts should be aligned with the waterway, especially on the outlet end. However, high skews should be avoided where possible to minimize costs. Culvert and excavation costs should be considered when selecting the alignment. The constructability of the culvert during traffic staging, including maintaining drainage during construction, may also be an important factor.

Vertical Alignment

Generally the slope of a pipe or box culvert should approximate the natural ground slope. When the slope of a pipe culvert is 5% or steeper, give consideration to a culvert type such as 1201 or 1501. When the slope of a box culvert exceeds approximately 2%, give consideration to some type of energy dissipater such as a drop inlet or a flume outlet. Also, give consideration to putting in verticals breaks in the slope, such as a “broken back” culvert, to minimize outlet velocities.

Culverts in Series

If two culverts in series are near each other, such as a mainline culvert and a culvert downstream under a ramp, generally keep the slope between the culverts to a minimum, perhaps 1% or less. This helps avoid erosion between the culverts. If a significantly steeper slope is unavoidable, a rock-lined ditch may be needed.

The hydraulics of the culverts in series should be carefully checked to accurately determine the influence of one culvert on any upstream culverts.

Length Determination

The length of culvert is determined by either the clear zone or by matching the proposed cross section, such as the barnroof slope. See Appendix A for design aid "Determining Culvert Lengths" which provides a more detailed explanation of how to determine this length and explains how to use the Computation Section on culvert pink sheets. See Road Typical 4304 and 4311 for foreslope shaping and cover over minimum length culverts.

Calculated concrete pipe lengths will be rounded up to the nearest even-numbered foot. Calculated lengths of Unclassified pipes will be rounded up to the nearest foot.

Slope Tapered Inlets

Slope tapered inlets on cast-in-place RCBs should be considered in some situations to reduce culvert costs and/or to create ponds for upstream landowners. The barrel size shall not be less than 50% of the inlet size. Also, to make construction simpler, the inlet dimensions shall be tapered only in the width, not in the height, e.g., a 12' x 8' inlet may be tapered to an 8' x 8' barrel section but not to an 8' x 6'. See Appendix A for specific design guidelines. Due to high velocities and large drop in elevation, most tapered inlet culverts will need a flume and a basin to dissipate energy.

Design guidelines for slope tapered inlets on concrete pipe culverts are shown in Appendix A.

If adequate fall is not available and inlet efficiency is necessary, side tapered inlets may be used

to improve inlet performance.

If a large pond is created by artificially raising the culvert inlet, the Iowa Department of Natural Resources may consider the culvert and road embankment as a dam and therefore have certain design requirements for the culvert and the embankment.

When a pond is created upstream, geotechnical concerns must be considered to ensure that seepage through the embankment is not excessive. Also, for traffic safety considerations, the road embankment should be designed so that a permanent pond is not up against the normal barnroof slope. For example, an earthen “bench”, perhaps 15’ to 30’ wide in cross section, can be built along the foreslope to keep the pond farther away from the highway and errant vehicles.

Drop Inlets

Cast-in-place drop inlets are used for minimum headwater depth situations for both RCB and pipe culverts. Drop inlets also provide good energy dissipation within the culvert. These inlets provide a convenient method of carrying flow from drainage tile across the roadway by discharging the tile through the inlet wall. Generally it is good practice to replace existing drop inlets in-kind in order to prevent an increase in headwater.

See Appendix A for design guidelines, a sample plan and profile, and a typical inlet detail. Design highwater elevation should not exceed the top of the butterfly wing, 3 feet (0.9 m) maximum above the drop inlet [weir] flowline). This wing has two purposes: 1. To hold the foreslope soil, and 2. To serve as an anti-vortex device.

Pipe railings are generally required on all drop inlets, even in rural areas, to prevent pedestrians from inadvertently falling into the culverts. In some urban areas, a grate over the drop inlet may also be needed to prevent deliberate entrance into the culvert, especially where pedestrian traffic is expected to be high or there is a large vertical drop, say greater than 6 feet.

Flumes and Scour Floors

Precast concrete "half-round" flumes (Road Standard RF-13) shall be limited in size to 42 inches (1050 mm) and in length to approximately 24 feet (7.2 m) to prevent the sections from pulling apart due to settlement and erosion. RF-14 pipe connectors shall be used on all half-round joints.

Cast-in-place flumes without basins (stub flumes) may be used when needed on RCBs 4’ x 4’ and smaller. Flumes with basins should be used on larger RCBs. The flow lines of stub flumes or basins or the “half-round” RF-13 are usually set approximately 5 feet (1.5 m) below the bed of the waterway. This allows for the natural development of a scour hole which helps dissipate energy. An estimate of the scour hole size should be made to ensure that adequate right of way is purchased. Riprap is generally not needed at flumes.

Minimum cast-in-place flume length is determined by the parabolic length, L_3 , as shown in OB&S Final Design Manual. Maximum flume lengths should be limited to approximately 60 feet (18 m), if possible, in order to reduce settlement problems and joint separations. See the Final Design Manual for other dimensions and notes.

When less than one meter of drop is needed on the outlet of short lengths of RCB extensions, consider using a "scour floor" in the headwall. See Appendix A for a sample sketch.

Median Pipes

Median drains should be placed to maintain the natural drainage as much as practical. Maximum spacing of median drains is 2000 feet (600 m) in sag vertical curves and 1500 feet (450 m) on tangent grades. For tangent grades greater than 2%, consideration should be given to 1000 foot spacing. If 18-inch (450 mm) diameter median drains must be used, spacing should not exceed 1000 feet (300 m).

For safety and settlement reasons, median drains should be placed transverse to the centerline of the roadway rather than "teed" into a crossroad pipe. These drains should generally outlet to the upstream side of the highway, when practical, so that outlet velocities and erosion is confined to the highway right of way and will not adversely affect adjacent property.

Vertical riser pipes into RCB's or pipes are generally not preferred.

Letdowns

Ditch "letdowns" should be used when the drop in ditch elevations becomes too great to carry the water without eroding the ditch. These pipe letdowns are depicted in the Road Design Details Manual, Items 1401 and 1403. The pipe material should be specified as a polyethylene or coated steel (which includes aluminum coated or polymeric coated per Standard Specification 4141.02).

Designing the outlets of letdowns through an RCB wall or flume wall is not desirable due to potential cracking in these walls. Rather, the outlets can be set beyond the headwall or on top of the wingwall or flume wall. The pipes should be anchored to the wall if resting on top of it.

Although the use of culvert letdowns is dependent on site conditions, a rough rule of thumb is that drainage areas of approximately 2-3 acres (one hectare) or less do not warrant culvert letdowns. The existing site conditions often provide helpful information in deciding if a culvert is necessary. For example, if the existing side ditch does not have a letdown or any erosion problems, then the proposed project may not need one either.

Consideration should be given in some circumstances to sideditch treatments such as sod, jute mesh, erosion stone, or riprap. Cost, type of soil, ditch slope, drainage area, and the preferences of the local DOT maintenance personnel are all factors in determining the proper ditch treatment.

Extensions

Existing RCBs and pipes shall generally be extended with an equivalent size and shape to closely approximate the hydraulic opening. For example, extend a 2' x 2' (600 mm x 600 mm) RCB with a 30" (750 mm) pipe, and extend a 3' x 2' (900 mm x 600 mm) RCB with a 37" x 23" (925 mm x 575 mm) concrete arch pipe or a 36" (900 mm) pipe.

The pipe and the RF-2 connections should have adequate earth cover and not project up into the subgrade or shoulder. There is not a practical equivalent shape for some existing RCBs (such as a 6' x 3' or 4' x 2'), so consider using the largest practical precast size that provides adequate hydraulic opening. If adequate earth cover is not possible with a precast extension, these RCBs may need to be extended in-kind.

A horizontal or vertical change of alignment between the existing pipe and the pipe extension requires an adapter (RF-2 or RF-13). See the section "Bends and Elbows" for more details on adapters, elbows and "D-sections"

See 1000-Series Typical for determining and labeling skews of extensions that are skewed to the existing culvert and/ or skewed to the roadway.

Culvert Liners

Common problems with old culverts include corrugated metal pipes that have rusted through, concrete pipes where joints have pulled apart and soil is coming through the joints, and small box culverts with deteriorated floors and walls where concrete is spalling badly and reinforcing steel is highly corroded.

Traditional solutions include open excavation and replacement, or jacking a new culvert alongside the existing one. However, another option is to push a liner, either metal or plastic, through the existing culvert and then grout the voids.

Advantages of these types of liners are as follows:

1. Installation is quick, generally less than a day, which is significantly less than it takes to excavate, remove, replace, cover, and place new pavement.
2. Traffic disruption is minimal, which is especially important for higher-traffic roads.
3. Equipment needs are minimal compared to conventional cut and cover.
4. Since open excavation is not needed, spot pavement replacement is not needed.
5. Potential settlement caused by excavating and then backfilling is eliminated.
6. Lining a pipe may be less expensive than open excavation or jacking, but comparisons should be made at each site. Obviously, as fill heights increase, the costs of open excavation increase.
7. DOT maintenance forces may be able to install the liner, although contracting this work is

also an option.

Disadvantages are as follows:

1. If the culvert has some bends or poorly aligned joints, a liner may not work unless it is significantly smaller than the existing pipe. Metal or PVC liners will bend very little, if at all. Polyethylene liners can bend a small amount, but if bent or kinked too much, the strength of the pipe may be significantly reduced leading to cracking or buckling in the future.
2. Reduced hydraulic capacity is potentially one of the biggest drawbacks to liners. Each site should be reviewed in the field and for existing and proposed hydraulics. Examine the risks of potential flooding upstream, water over the road, and inadvertent diversion of drainage during high flows to a culvert in an adjacent watershed. A full hydraulic analysis of both the existing and liner culverts should be made, including inlet and outlet control calculations. At least one pipe liner manufacturer suggests that a smooth liner with a lower Manning's n -value will give better hydraulics than an existing culvert with a higher n -value. However, this may not be true depending on site conditions, so the full hydraulic analysis is important.
3. Both corrugated metal and plastic liners are defined as flexible pipes and therefore do not have much strength to carry earth pressures without surrounding material, such as grout, to support them. Without this support, the liner can crush or fail over time. If the liner is installed in a concrete pipe where the joints have pulled apart slightly but the pipe itself is still in good condition, the existing concrete pipe may still carry the earth load for many years. However, if the culvert is in very poor structural condition, such as a badly corroded metal pipe, the liner will need to carry all the earth load. Therefore, the backfill material, i.e., grout, is critical. Do not underestimate the importance of this.
4. The life of the liner material may not be as long as the life of a concrete pipe installed by jacking or open excavation.

There are several important factors to consider when designing and installing the liner:

1. The liner must be sized correctly. For hydraulic performance, the pipe may need to be as large as possible. But to push the liner through the existing culvert, it must not be too large. One manufacturer recommends that the outside diameter of the liner be approximately 10% less than the inside diameter of the existing. Bends or misalignments in the existing culvert would also need to be considered. Various materials are available for use as liners: corrugated metal (galvanized or aluminum-coated), polyethylene and PVC. At least one manufacturer produces a thin, solid-wall polyethylene liner.
2. The existing culvert should be clean enough to easily push the liner through.
3. Using a properly designed grout mix, fill all the voids that surround the liner. Too much sand in the mix or too stiff of a mix may result in voids not completely filled. Too much water in a mix may not provide enough strength for the earth loads on the liner. The DOT's maintenance forces have successfully used the standard mix for flowable mortar, so this mix should be considered.
4. When the grout is pumped into the voids, the liner will float due to buoyancy. If maintaining the existing culvert flowline is critical, a small amount of grout should be placed and then allowed to cure. This process should be continued until the bond between the liner and the grout is enough to resist buoyant forces. Then the remainder of the voids can be filled. Another approach to prevent flotation is to install braces in the top of the existing culvert to

hold the liner in place during grouting. However, use this approach with caution since buoyant forces can be significant enough to crush the liner against the braces. A third approach to prevent flotation is to fill the liner with water before grouting the voids.

Minimum Cover

Minimum cover on all pipes is 2 feet (0.6 m), or the top of the structure should be at or below the subgrade elevation. This minimum should be measured within the roadway limits (outside to outside of shoulders). Preferred minimum cover over a roadway pipe in the median is one foot (0.3 m) of soil.

As stated previously, when the 2-foot minimum cover cannot be obtained, consider using arch pipes or twin pipes instead a single, larger diameter round pipe.

Uplift of Culvert Inlets

For corrugated metal or polyethylene pipes with diameters of 48" (1200 mm) and larger, cast-in-place headwalls, precast concrete aprons (Road Standard RF-3), or concrete collars should be considered on the inlet to prevent failure due to uplift forces. For 48" (1200 mm) to 84" (2100 mm) diameter culverts, an alternative is to use a concrete pipe instead of CMP.

Bends and Elbows

For culvert bends in the horizontal plane, the limit at a single bend shall be 20 degrees for pipe culverts and 15 degrees for RCBs. Larger RCB bends up to 20 degrees may be considered on a case-by-case basis. Multiple bends are permitted. Limiting the angle in a bend will minimize hydraulic losses and tendencies for plugging of the bend with debris.

To simplify design and construction, do not use radial designs for RCB bends. Rather, design the barrel in chords. Multiple bend sections should be a minimum 10 feet (3 m) long per section. See the Office of Bridges and Structures' Final Design Manual for a note on curved box culverts.

For horizontal bends in pipes up to 7.5 degrees, use an RF-13 "D" section or an RF-2 Type C-1 or C-2 connection. "D" sections may also be used in series to provide an overall culvert bend of 15, 22.5, 30 degrees, etc.

RF-13 elbows shall generally be specified to the nearest degree.

For small changes in vertical alignment in concrete pipe, use an RF-2 Type C-1 connection if the joint opening will exceed $\frac{3}{4}$ " (20 mm) at the top or $\frac{1}{4}$ " (5 mm) at the bottom.

Road Details (Typicals)

See Appendix A for guidelines on properly using the 1000 Series drainage details from IDOT Road Design Details Manual---"Green Book".

Plan Preparation

The difference in plan details for pipe culverts and for RCB culverts may be confusing, so the following details will provide clarification. The plan and profile drawing for a pipe culvert will be called a plat plan. The plan and profile for an RCB culvert will be called a Situation Plan and, in general, consists of more detail than a plat plan.

A primary purpose of culverts plans is to visually and graphically aid the designer in developing proper lengths and locations of culverts, because individual cross sections commonly do not show the exact drainageway elevations or the alignment of the drainageway. The completed drawings are often used during construction or in later years if drainage complaints arise. During the project design, the Office of Right of Way also uses the drawings to help determine right of way needs, and the Office of Design uses them as an aid to compute earthwork quantities.

The plat plan or Situation Plan should include enough ground elevations to accurately define the area. All draws, draw junctions, banks, existing structures (including flowlines and lengths), fence lines, tile lines, utilities, and other pertinent existing features should be shown. The proposed structure, including flowlines, lengths, skews and special features should be shown. See Appendix A for a checklist of items to include on plat plans for pipes and Situation Plans for RCBs.

Ground elevations should be shown along the drainageway at least 30 meters upstream and downstream of the culvert. Contours should be clearly labeled. Proposed toe of slope lines (foreslope, ditch lines, backslopes) should be shown at least 45 meters ahead and back of the culvert stationing.

Both the plan and the profile view should be plotted with a 1"=40' scale for English projects (1:500 for metric projects) as measured on an 11"x17" drawing. (This refers only to the plotted scale and does not refer to any "working scales" as used while actually in a CADD file.) Do **not** use a distorted scale in the profile view. Sample plans may be found in Appendix A for both pipes and RCBs.

For the plan view, the roadway should generally be oriented vertically on the plat.

The profile view should generally be drawn normal to the roadway so that foreslopes are shown as true slopes. Therefore, for skewed culverts, the true length will not be shown.

"Pink" Sheets

Culvert "pink" sheets (IDOT Form 621001) have four primary purposes:

1. Provide field information such as culvert location, drainage area, existing culvert flowlines, etc.
2. Aid in the design process, including the computation of culvert lengths.
3. Develop the culvert bid tabulation for the final road plans.
4. Provide a permanent record for the culvert

Pinks must be filled out completely.

See Appendix A for an explanation on how to properly use the Computation section on the pinks. Consultants should obtain prior approval before using other methods for length computations.

Sample completed pink sheets are also in this appendix. Upon submittal of final grading plans by consultants, the completed pinks and culvert plats shall also be submitted to IDOT and kept as a permanent record.

Approvals

Iowa Department of Natural Resources must approve new culverts if the drainage is greater than two square miles (5.2 square kilometers) in an urban (incorporated) area or 100 square miles (259 square kilometers) in a rural (unincorporated) area. If the project is on a stream with drainage area below DNR's thresholds and if the community (city or county) is participating in the National Flood Insurance Program (NFIP), a hydraulic review and coordination with the community are necessary to ensure compliance with the NFIP.

A sample DNR application letter and form is included in Appendix B.

A Corps of Engineers 404 Permit may be necessary for most stream crossings and road work if a channel change or wetland is involved. IDOT's Office of Environmental Services coordinates this effort.